FY'00 Proposal for the NASA Electronic Parts and Packaging Program

#2 (To be combined with #95)

TITLE: Optoelectronic and Photonic Devices

NPPP PROJECT GROUP: Electronics Parts Project

RESPONSIBLE CENTERS: JPL

SUPORTING CENTERS: GRC

PROGRAM OBJECTIVES: The objectives of this task include the following:

1. Establish a qualification plan of newly developed optoelectronic devices,
2. Identify the advantage of the new devices over the existing state-of-the-art photonic devices,
3. Collect experimental data and develop numerical models to assess the relationship between device lifetime and degradation in high reliability optoelectronic imaging and communication applications.
4. Investigate common failure mechanisms of optoelectronic and photonic device.

DESCRIPTION AND APPROACH:

With the recent advancements in optoelectronic and photonic devices, optical communication and data analysis on-board spacecraft are becoming an achievable dreams, integrating signal receiving and data processing in miniaturized systems for optical communication and imager. This new technology however relies on photonic lasers, transmitters, and receivers suitable for space applications, such as InGaAs and AlGaAs laser diodes as well as optical fiber material and HBTs and HEMTs used in readout circuits. In addition, performance characteristics such as spectral dispersion, detectivity, and cross-talk among the receiver arrays must be fully examined for reliable imaging and space communication applications.

In this effort, we propose to collect experimental data, such as Quantum Efficiency, Frequency, and Operating Temperatures, and develop a numerical model to assess the lifetime and degradation of optoelectronic detectors and data processing integrated devices for potential future use in space mission communication applications. This model will be based on data collected from device manufacturers, on-lab experimental results, and through reliability literature. We will also compile a comprehensive list of failure mechanisms and reliability issues related to optoelectronic or photonic devices.

The outcome of this effort will include a comprehensive comparison report with the optoelectronic imaging devices planned for use in EOS missions such as

Multi-angle Imaging SpectroRadiometer (MISR), Laser Interferometer Space Antenna (LISA), and Advanced Space Borne and Thermal Emission Reflection Radiometer (ASTER). This information will be applied to prepare a new technology infusion qualification plan for the device application in space, and published in suitable technical journals. The model will be made available to NASA designers for use in circuit and system design and component selection for the space missions.

DELIVERABLES:

The results of this task will have the following deliverables:

1. Report of nominal device performance data, common failure modes, and their mechanisms.
2. Lifetime and degradation model for optoelectronic communication devices.
3. Final report including recommendations for application and use of optoelectronic devices in optical communication and other high reliability applications.
4. Qualification plan of the device, technical papers and publications.

PARTNERSHIPS AND ENDORESEMENTS:

1. Partner:
   Glenn Research Center
   Collaboration with Sensor Unlimited, Inc.
2. Endorsement:
   Earth Observation Systems of GSFC

SCHEDULES & RESOURCES:

Technology Survey	Q1/00
Data Collection	Q2/00
Model Development	Q3/00
1st Year Report	Q4/00
Device Characterization	Q1/01
Reliability Analysis	Q2/01
Quality Assurance Procedures	Q3/01
Final Report	Q4/01

PRINCIPAL INVESTIGATOR or CONTACT

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TITLE: **Reliability Assessment of *HIGH POWER* LASER Diodes for Use in LEO and Aircraft Avionics**

#95, NEPP PROJECT: Electronic Parts

POINTS OF CONTACT:

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OBJECTIVE:

Assess Reliability of LASER Diodes utilized in a Wide Variety of LASER, LIDAR, DIAL Remote Atmospheric Sensing and Avionics Applications.

APPROACH:

Systems Mission Paradigms are Effecting Performance of Space and Atmospheric Sciences Remote Sensing Applications. Develop Reliable Models and Validation Tools to Enable Efforts by Electronics Designers to Insert Best Solutions into Upcoming Instruments and Missions.

Use Existing Data Collected by LaRC during the Development of LIDAR *and* DIAL Atmospheric Science Instruments to *Establish* Models and Validate them for use by other Systems Designers.

Provide Active Modeling Component via WWW Data Site to Discriminate Results.

Evaluation and Qualify Models to Provide Assessments directly to COTS Devices and Other Sources of Diodes for LASER Imagining Applications.

Increase Packaging Options for Electronic Designers Dealing with COTS Performance vs. Mission Environment.

DELIVERABLES:

Working WWW Modeling Portal to Evaluate Electronic Systems Options that Will Deliver Improved Operation for All Types of Atmospheric Science Remote Sensing Platforms <Aircraft, Space Station based instruments, LEO instruments>.

Detailed Testing Required To Qualify Working Interface to Model Design and Processes.

Conduct Qualification Validation of Models for High Power LASER Diode Pump Arrays

Assessment and Conduct Industry Workshop to Disseminate Results to Academia and Industry Partners.

PARTNERS:

NASA CENTERS:
LaRC, JPL

LEVERAGING SEMICONDUCTOR INDUSTRY:

POTENTIAL CANDIDATES: SDL, Inc.; Opto Power Corporation; Coherent Semiconductor Laser Group; Industrial Microphotonics Company, Polaroid, Thomson-CSF; Siemens

ENDORSEMENTS:

Beneficiary Programs/Projects

- NEPP Program (Code AE)
- New Millennium Program (Code Y, S)
- X2000 Program (Code S)
- Mission to Planet Earth (Code Y)
- Manned Flight (Code M)
- FOSS (Code M)
- LASE (Code S)
- GAMS (Code Y)
- Manned Flight (Code M)
- X-33 Vehicle Health Monitoring (Code R)
- PICASSO-CENA (Code Y)
- SPARCLE (Code Y)

COST: **(Revised 4/22/99*)***

CENTER	FY00	FY01	FY02	FY03
LaRC	***$120k***	***$120k***	***$140k***	$140k

JPL	See proposal #2	$90k	$90k	***$50k***

LIST OF PROCUREMENTS AND ACQUISITIONS EXCEEDING $2k:

	FY00	*FY01*	*FY02*	*FY03*
LaRC	**$10K/travel $40K/test parts i.e. 808 & 795 nm, 60 W/bar, conductively cooled 1D & 2D QCW diode pump arrays & equipment**	**$10K/travel $60K/test parts i.e. 808 & 795 nm, 100 W/bar, conductively cooled 1D & 2D QCW diode pump arrays & equipment**	**$10K/travel $60K/test parts i.e. 808 & 795 nm, 100 W/bar, conductively cooled 2D QCW diode pump arrays**	**$10K/travel $60K/test parts i 808 & 795 nm, lensed, conductively co 1D &2D QCW di pump arrays**

Personnel:

LaRC	*FY00*	*FY01*	*FY02*	*FY03*
CS	**0.5 FTE**	**0.5 FTE**	**0.5 FTE**	**0.5 FTE**
Non CS	*0.5 MY @ $50K*	*0.5 MY @ $50K*	*0.5 MY @ $50K*	*0.5 MY @ $*

SCHEDULE:

Quarter	**Activity**
1FY00	Literature Search
2FY00	Test Samples Acquisition
3FY00	Baseline LDA Data Collection
4FY00	Test Samples Characterization, Model Development
1FY01	First Year Report
2FY01	Device Testing and Characterization
3FY01	Array Reliability Analysis
4FY01	Model Refinement
1FY02	Second Year Report
2FY02	WWW Portal for Data
3FY02	Array Qualification Plan
4FY02	Hybrid Array Reliability Analysis
1FY03	Third Year Report
2FY03	Model Finalization
3FY03	Hybrid Qualification Plan and Publication
3FY04	Final Report